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Argon Laser Iridoplasty to Improve Visual Function Following Multifocal Intraocular Lens Implantation

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ABSTRACT

PURPOSE: To describe the use of argon laser iridoplasty following implantation of a multifocal intraocular lens (IOL) to improve visual function.

METHODS: Argon laser spots of 500-mW power, 500- μ m spot diameter, and 500-ms duration were placed in the midperipheral iris in the area in which the iris was encroaching on the IOL.

RESULTS: Argon laser iridoplasty provided statistically significant improvement in visual function including corrected distance visual acuity (CDVA) and subjective quality of vision in 14 eyes from 11 patients. Mean CDVA improved from 0.24 (20/35 Snellen) to 0.10 (20/25 Snellen) logMAR ($P < .0001$), and mean subjective quality of vision improved from 2.9 to 7.5 ($P < .0001$).

CONCLUSIONS: Argon laser iridoplasty should be considered in correcting visual problems associated with decentered multifocal IOLs. [*J Refract Surg.* 2012;28(4):281-283.]

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Multifocal intraocular lens (IOL) implantation can result in poor quality of vision. Residual refractive error, ocular surface disease, posterior capsule opacification, and macular pathology can all impact negatively on vision in the presence of a multifocal IOL.^{1,2} An additional cause of loss in quality of vision is decentration of a multifocal IOL relative to the pupil.

The optical axis of the eye is the line connecting the geometric centers of the cornea and crystalline lens in the phakic eye and the cornea and center of the bag (and IOL) postoperatively. The visual axis is the line connecting the object of fixation and the foveola through the nodal point, which is near the posterior vertex of the crystalline lens or IOL. The angle between the optical axis and visual axis is referred to as angle alpha and is $\sim 5.2^\circ$ (0.6 mm) in human eyes. The center of the pupil usually is half-way between the optical axis and visual axis (vertex normal), and is therefore $\sim 2.6^\circ$ (0.3 mm) temporal to the visual axis and is referred to as angle kappa. The angle between the optical axis and pupillary center is angle alpha minus angle kappa and is also $\sim 2.6^\circ$, but varies widely from patient to patient. Therefore, an IOL perfectly centered in-the-bag usually is temporal to the pupil.³ Due to the concentric ring and aspheric design of diffractive multifocal lenses, decentration may impair certain aspects of a patient's vision. When the diffractive rings of a multifocal IOL are not concentric with the aperture (pupil), the balance of the diffractive rays becomes distorted, resulting in uneven

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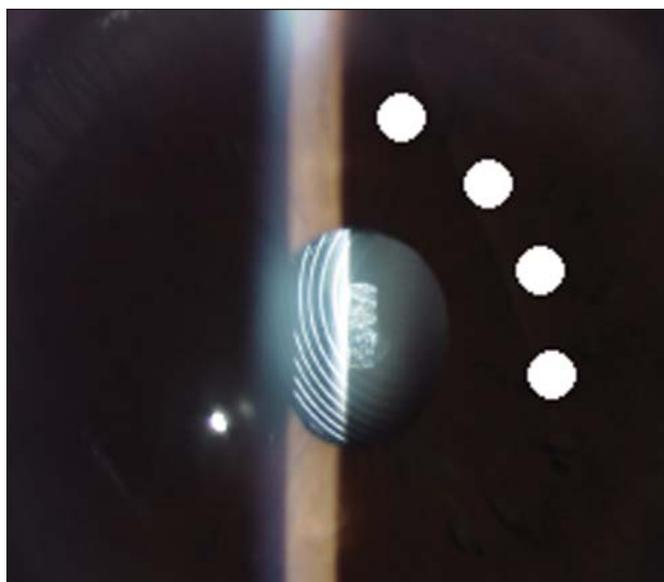


Figure 1. Multifocal intraocular lens decentered behind the pupil with white spots illustrating the intended site of argon laser.

light scatter with consequent contrast and resolution loss of the retinal image, which the patient describes as “waxy” vision. All aspheric IOLs when decentered create coma, which can degrade quality of vision.⁴

SURGICAL TECHNIQUE

Consecutive patients with multifocal IOLs that were not centered behind the pupil (Fig 1) were recruited. Argon laser iridoplasty (wavelength 514.5 nm) was performed by creating four laser spots of 500-mW power, 500- μ m spot diameter, and 500-ms duration in the midperiphery of the iris in the area in which the iris encroaches on the center of the IOL. The iris in the treated area retracts, exposing the covered section of the multifocal IOL (Fig 2). Four laser spots were placed initially and the number was titrated to the amount of pupil movement required to achieve centration of the IOL behind the pupil. In dark irises, which absorb the argon laser energy effectively, the iris may begin to char and contract. In these cases, less energy was required. For blue irises that did not respond and did not contract, more energy was needed. Each patient was pretreated with one drop of topical ophthalmic anesthetic and no contact lens was used for the laser procedure. Patients were prescribed topical loteprednol 0.5% four times per day for 1 week following the laser treatment.

RESULTS

Fourteen eyes from 11 patients with at least 0.3 mm of decentration of the pupil center relative to the center of the IOL underwent argon laser iridoplasty to center the pupil over a multifocal IOL. All patients provided

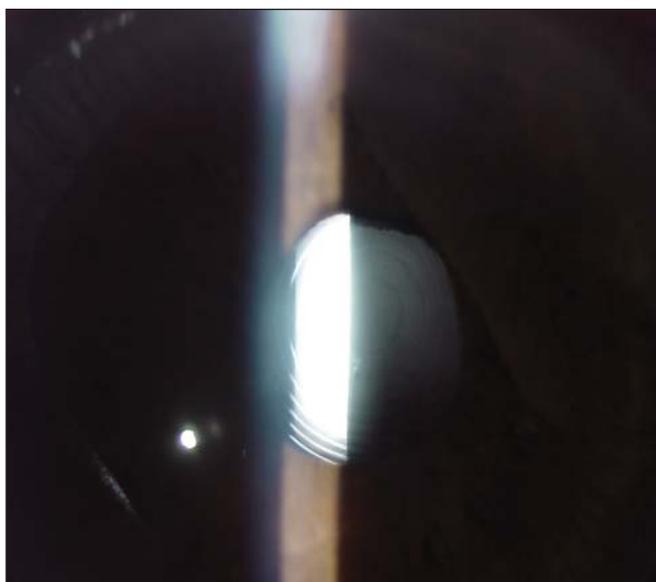


Figure 2. Multifocal intraocular lens after argon laser iridoplasty centered behind the pupil.

informed consent and were treated by the same surgeon (E.D.D.). All eyes had previously undergone uncomplicated cataract surgery at least 3 months prior to argon laser iridoplasty.

Argon laser iridoplasty was performed after all contributing factors for glare and halo were treated. Contributing factors included residual refractive error, ocular surface disease, posterior capsule opacities, and cystoid macular edema. Corrected distance visual acuity (CDVA) and patient subjective quality of vision were measured prior to argon laser iridoplasty and 1 month postoperatively. Mean CDVA improved from 0.24 (20/35 Snellen) to 0.10 (20/25 Snellen) logMAR ($P < .0001$), and mean subjective quality of vision improved from 2.9 to 7.5 ($P < .0001$) on a scale of 1 to 10. No postoperative complications occurred. No eye lost lines of CDVA or had worse symptoms postoperatively.

DISCUSSION

Quality of vision is reduced in all patients receiving a multifocal IOL due to the separation of light and the two images formed on the retina. These issues are compounded with IOL decentration. The optics of multifocal IOLs improve with proper centration although in some patients relative decentration is well tolerated.³ Excellent centration is required to maximize the visual outcome of wavefront-corrected IOLs.⁵ The effects of decentration have been shown to decrease optical performance in bifocal contact lenses.⁶

All IOLs, whether monofocal or multifocal, exhibit astigmatism and coma when decentered or tilted. Furthermore, the pupil is decentered inferonasally in a significant portion of the population.⁷ As a result, the

IOL appears to be decentered superotemporally. The misalignment with the pupil can cause visual symptoms for the patient, and surgical recenteration of the lens may be unsuccessful due to the fact that the IOL is already properly centered within the capsular bag.⁸

The pupillary center is normally nasal to the optical axis of the eye by $\sim 2.6^\circ$ (0.3 mm). When the rings of a multifocal IOL are not concentric with the patient's pupil, the balance of the diffracting rays becomes asymmetric. Patients may complain of reduced quality of vision of daytime images and asymmetric halos around lights at night and "waxy" vision.⁹ In the case of mild decentration, these visual complaints are worse with diffractive multifocal IOLs than refractive multifocal IOLs.¹

Argon laser iridoplasty should not be considered in patients who have IOL decentration relative to the pupil but are visually asymptomatic. In the United States Food and Drug Administration trial of the ReSTOR IOL (Alcon Laboratories Inc, Ft Worth, Texas),¹⁰ these patients had no visual complaints. However, in patients who are having excimer laser photoablation to correct residual refractive error following multifocal IOL implantation, the use of argon laser iridoplasty to center the pupil over the IOL can be helpful. Otherwise, the photoablation will be centered on the pupil and decentered on the lens, which will induce significant higher order aberrations.

Argon laser iridoplasty to recenter the pupil over the IOL is an effective procedure. After treating contributing factors such as astigmatism, ocular surface disease, posterior capsule opacities, and cystoid macular edema, argon laser iridoplasty should be considered in correcting visual problems associated with decentered multifocal IOLs. Results show a statistically significant improvement in CDVA and subjective quality of vision with no postoperative complications.

AUTHOR CONTRIBUTIONS

Study concept and design (R.S., J.H., E.D.D.); data collection (R.S., E.D.D.); analysis and interpretation of data (R.S., A.B., A.V., M.B., H.D.P., E.D.D.); drafting of the manuscript (R.S., A.B., A.V., E.D.D.); critical revision of the manuscript (R.S., A.B., A.V., J.H., M.B., H.D.P.); administrative, technical, or material support (R.S., A.B.); supervision (R.S., A.B., E.D.D.)

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